ISD Requirements Management

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Approved By: (signature)
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Responsible Office: 580/Information Systems Division (ISD)
Title: Software Requirements Management

Asset Type: Process
PAL Number: 2.2.2

Purpose

The purpose of the Requirements Management process is to maintain current, correct and under control a documented common understanding of customer needs, intended product use, development resources, constraints, and needed software capabilities that were captured and baselined in software requirements documentation.

The process describes the tasks necessary to correct, update, and control detailed software requirements.

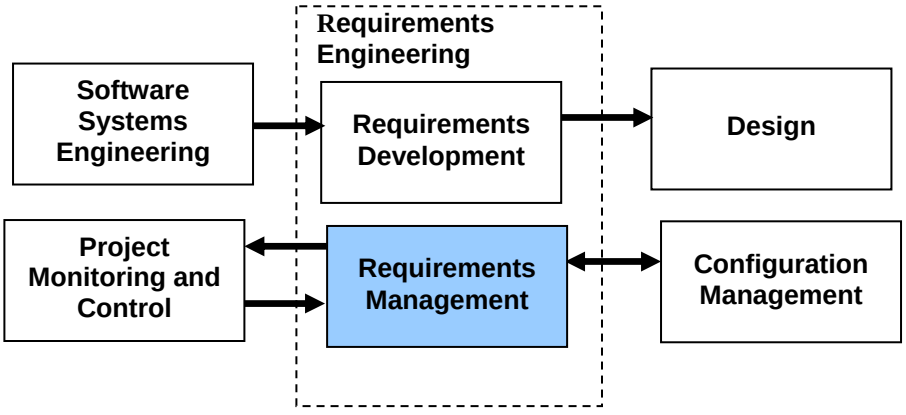
The result of this process is an updated organized set of documented requirements during the software product life-cycle that:

- Supports the customer's needs, goals, and objectives
- Remains within a well defined scope
- Supports tracking and recording of costs and efforts
- Identifies current resources and constraints
- Identifies and quantifies impacts of changes including those of scope, schedule, cost, hardware, and staffing
- Maintains current and under control the documented Software Requirements.

Scope

This process applies to the development or modification of ISD mission software, typically in classes A, B, and C software as defined in NPR 7150.2.

Context Diagram



Roles and Responsibilities

Change Requestor

- Provides needs, expectations, and constraints embodied in the change
- Provides detailed understanding and justification of change requested
- May identify additional external interfaces
- Evaluates modified requirements as to addressing changes

GUIDANCE: This may be from any of a number of roles including the Customer, the Operations Staff, Development Team Lead, Maintenance Team Lead, or Product Development Lead.

Author

- Collects and researches the effects of changes requested on the existing body of requirements, interfaces, operational concepts, operational scenarios and traceability
- Documents proposed changes to functionality as expressed in operational concepts, and operational scenarios documentation
- Documents proposed changes to software requirements and specifications
- Documents estimated impact to resources, capabilities, schedule, and cost
- Tracks and implements changes to requirements and all affected documents after approval

GUIDANCE: The Author is often the Development Team Lead prior to release and the Maintenance Team Lead after release. Documentation may be in the form of "change pages" to the baseline requirements document or affected documents.

Development Engineer (a.k.a. Software Developer)

- Provides the Author with inputs on feasibility, alternative approaches, cost and schedule impacts
- Tentatively allocates requirement changes to design changes for impact analysis
- Identifies interface changes required

GUIDANCE Often more than one software developer is used for various aspects of the work. On small projects the role may be filled by the development team lead or by consultation with senior staff.

Interface Representative

- Works cooperatively to assess and coordinate necessary changes to an affected interface.
- Assesses resources needed to support changes required to an interface and assures that the affected item is maintained and controlled.

GUIDANCE: This will usually be the Affected Product Development Team Lead (PDL) or Affected Software Manager and may be held by a manager or a technical representative.

Reviewer

- Validates requirements as to consistency and feasibility

- Verifies requirements as to satisfying needs for the reviewer's area of knowledge and expertise.

GUIDANCE: This is a member of a team which may include CCB, PDL, Customer, Software Assurance Engineer, and other stakeholders.

Configuration Manager

- Maintains the integrity of managed requirements through configuration identification, configuration control, configuration status accounting, and configuration audits.
- Maintains a history of change requests, dispositions, and approved versions of requirements documents.

GUIDANCE: This may be a project librarian or an adjunct to the Change Control Board.

Entry Scenarios

This process is entered upon receipt of a change request that is written by the requestor whenever there is a change in identified requirements or needs.

GUIDANCE: Possible conditions precipitating a change are:
- A latent in-scope requirement is identified
- The software project is re-scoped (requirements added, dropped or modified)
- An inconsistency is identified between the capabilities of the product developed and the documented requirements.

Inputs

- Requirement Change Request

GUIDANCE: This is a statement of changes to needs and goals or interfaces. The change request should be accompanied by supporting documentation as appropriate (e.g. changed higher level documents.)

- Managed Requirements

GUIDANCE: This is the current set of controlled requirements documentation.

- Traceability Matrices

GUIDANCE: These are the bi-directional tracing of all current requirements from their source to their intended implementation.

Entry Criteria

- A Requirement Change Request has been made.

Exit Criteria

- Decision was made through the PMC process not to proceed with the change

---- OR ----

- Updates to requirements made, distributed and controlled
- Other work product change requests have been generated as required

GUIDANCE: Related documents impacted by accepted changes are managed by additional change requests.

Outputs

- Impact Analysis
- Updated Requirements
- Changed Interface documents
- Updated Traceability Matrix
- Notification of Change to affected parties

GUIDANCE: For all changed documents:

- *Clearly identify changes*
- *Assure approval of changes by affected parties*
- *Allocate responsibility for implementation of requirements changes to software, people, hardware, and subsystems*
- *Maintain a history of changes and modifications*

Major Tasks

1. Analyze Change Request for impact and feasibility [Author, Requestor, Customer, Developer, Interface Representative]
2. Prepare an impact statement [Author]
3. Obtain approval of the change requested {Author, Approver]
4. Generate changed Requirements, Specification, and change requests for other controlled products as necessary [Author]
5. Verify changed Requirements and Specifications [Author, Customer, Developer, Interface Representative, Reviewer]
6. Validate changed Requirements and Specifications [Author, Customer, Developer, Interface Representative, Reviewer]
7. Update and distribute updated documentation as necessary [Author]

Task 1:

Analyze Change Request for impact and feasibility [Author, Requestor, Customer, Interface Representative, Developer]

Guidance: The author leads the effort and works with the Customer and Development Engineer. If a change to an interface is necessary, an Interface Representative is needed.

a) Examine, discuss, and understand the change requested to determine functional requirements added, modified, or deleted.

b) Capture the urgency and criticality of the changes requested from the Customer and Requestor.

c) Analyze the change requested for its impacts including:
   - Changes required to systems, subsystems and components
   - Changes to requirement allocations
   - Benefits
   - Resources
   - Risks

d) Estimate effort, costs, and schedule required to implement the changes requested including affected subsystems and components

e) Negotiate the scope of requested changes to minimize impacts and remain within allocated resources if possible

f) Recognize and document assumptions made in conducting the analysis

Task 2:

Prepare an impact statement [Author]

a) Compile the findings of the analysis into a feasibility and impact analysis report.

b) Document Changes needed to Requirements, Specifications, and other work products
   - Document changed operational scenarios.
   - Document changes needed to Interface Control Documents (ICD's), Interface Requirements Documents (IRD's), and Memos of Understanding (MOU's)
   - Trace changed requirements up to high level requirements and down to Subsystems, Components and Verification methods in matrices

GUIDANCE: For small changes, the impact analysis package may include excerpted document changes; for large changes, the impact analysis may be iterative, consisting of a preliminary impact analysis and, after approval to proceed, a more detailed analysis of affected items and expected costs undertaken.

Task 3:

Obtain approval of the Change Requested {Author, Approver]

a) The author presents the results of the impact statement and changed requirement documentation to the necessary approving parties and obtains signed approval to proceed.

Guidance: All affected parties should be involved in the approval process to maintain the common understanding of the end product.

Task 4:

Generate changed requirements, specifications, and change requests for other work products as necessary [Author]

a) The author formally changes all requirements documents necessary to effect the requested change.

b) Change requests for parent documents are issued as necessary.

c) Change requests for interfaces are issued as necessary.

Guidance: The author formally changes requirements documents to address the changes necessary to effect the change requested.

Task 5:

Verify Requirements & Specifications. [Author, Customer, Developer, Interface Representative, Reviewer]

GUIDANCE: The Author coordinates a team including Customer, Developer, Interface Representative, Reviewer, and Approver to examine the updated requirements. The team uses comprehensive methods to assure the resulting requirements are consistent, complete, and feasible. Subtasks include the following steps which may be repeated as necessary and performed sequentially or in parallel.

a) Conduct requirements peer-reviews to ensure agreement regarding the intent and purpose of each requirement change and the reason for limits, tolerance and margin in each specification.

Guidance: The peer review process is described in NPR 7150.2.

b) Clarify ambiguous requirements.

c) Determine the technical feasibility of each modified requirement and any risks inherent in candidate approaches.

GUIDANCE: Some items which may indicate risk include: incomplete information, technology readiness level, schedule issues, cost issues, uncertainties, missing stakeholder input, and incompletely defined interfaces. Priority issues should be addressed during these discussions.

d) Verify consistency, necessity, and completeness both internal to the requirements and against driving documents

GUIDANCE: Complete requirements should cover nominal and off-nominal interfacing software and hardware scenarios. Obtaining approval may require iterating tasks.

e) Model performance or prototype as needed.

f) Update the traceability matrix to record the verifications performed on the requirements and expected in their design and implementation.

Task 6:

Validate Requirements & Specifications. [Author, Customer, Developer, Interface Representative, Reviewer]

GUIDANCE: The Author offers for review the updated requirements for the benefit of all stakeholders including the Customer(s), Product Development Team, Interface Representative(s) and end users. The team uses comprehensive methods to assure the generated requirements are correct, complete, and feasible. Methods suggested include reviews, prototyping, hand calculation, and paper simulations.

a) Determine and document the method of validation to be used for each modified requirement.

b) The author may conduct a Changed Software Requirements Review (Delta SRR) to present the modified requirements to all stakeholders or issue the changes for independent review.

c) Collect and track all issues resulting from any reviews as Review Item

Dispositions (RID's) or Requests for Action (RFA's).

Task 7:

Update and distribute updated documentation as necessary. [Author, Approver]

a) Update the requirements as necessary to address RID's, RFA's, and issues to represent approved changes.

b) Obtain signed approval of the final to proceed with development.

GUIDANCE: Signatures should include both customer and developers.

c) Distribute the signed, updated requirements and specifications.

Measures

Recommended Measures:

- Estimated Costs
- Function Points or Lines of Code estimate
- Count of latent requirements discovered
- Count of requirement changes, deletes, or additions
- Changes to work scope
- Effort expended to analyze and estimate changes

Tools and Templates

Name	Description
Contents of the Software Requirements Review	Checklist for Contents of the Software Requirements Review http://software/AssetsApproved/PA2.2.1.6.doc http://software/AssetsApproved/PA2.2.1.6.pdf
CORE	Tool supporting model-based systems engineering and product design including requirements analysis http://www.vitechcorp.com/CORE/productline.html
DOORs	Requirements tracing aid – http://www.telelogic.com/products/doorsers/doors/
FSW Requirements Document Template	http://software/AssetsApproved/PA2.2.1.2.1.doc http://software/AssetsApproved/PA2.2.1.2.1.pdf
FSW Requirements Review Standard	http://software/AssetsApproved/PA2.2.1.6.1.doc http://software/AssetsApproved/PA2.2.1.6.1.pdf
Rational Rose	Requirements tracing aid - http://www.rationalrose.com/
SLATE	Requirements tracing aid http://www.sdrc.com/

Training

Course Name	Description
Requirements Engineering Workshop	Available from Teraquest, 3-4 day course (ISD Training Plan) HQ001
Mastering the Requirements Process	Available from SQE, 3 day course (ISD Training Plan)

NPR 7150.2/IEEE 12207 Class	Dr. Lewis Gray describes a mapping of IEEE 12207 to NPR 7150.2.
Software Requirements Development	ISD Training Plan - ISD009
System Requirements	

- **ETVX Diagram:** A hyper-link to this diagram can be found in the Process Asset Library on-line version of this document.
- **Glossary:** **http://software.gsfc.nasa.gov/glossary.cfm**
  Defines common terms used in ISD processes
- **IEEE 830-1998: Recommended Practice for Software Requirements Specifications** (available through: **http://standards.nasa.gov/npts/login.taf at http://standards.ieee.org/catalog/olis/se.html)**
- **NPR: 7150.2: NASA Software Engineering Requirements** **http://software.nasa.gov/npr_7150_2/index.cfm**
- **Process Asset Library:** **http://software.gsfc.nasa.gov/process.cfm**
  Library of all ISD process descriptions
- **In-House Development And Maintenance Of Software Products – GPG 8700.5** **http://gdms.gsfc.nasa.gov/gdmsnew/srv/GDMSNEWDatabaseObject?document_id=6152**
- **SQ Software Specification Review (SSR) Product Checklist** **http://sw-assurance.gsfc.nasa.gov/disciplines/quality/checklists/pdf/software_specification_review.pdf**
- **SQ Software Requirements Specification (SRS) Document Checklist** **http://sw-assurance.gsfc.nasa.gov/disciplines/quality/checklists/pdf/software_requirement_specification.pdf**
- **Systems Engineering – GPG 7120.5A –** **http://gdms.gsfc.nasa.gov/gdmsnew/srv/GDMSNEWDatabaseObject?document_id=6153**

Quality Management System Records

Controlled Document / Description	Record Custodian
Requirements Document	*Configuration Manager*
Traceability Matrix	*Configuration Manager*
Change Requests	*Software Manager*

Change History

Version	Date	Description of Improvements
1.0	June 1, 2005	Initial version approved by CCB